T 255 / T 265 TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING AND LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

1. Which of the following statements regarding minimum sample mass is true?
   a. Aggregate sample mass is based on Maximum Particle Size. Soil sample mass is based on Nominal Maximum Size.
   b. The required mass for any aggregate sample is always larger than soil sample mass regardless of the actual particle size present in either of the materials.
   c. Aggregate sample mass is based on Nominal Maximum Size. Soil sample mass is based on Maximum Particle Size.
   d. None of the above. Any convenient sample mass may be used for either aggregate or soil provided that mass determination is made to at least the nearest 0.1 gram.

2. When determining moisture content according to this FOP, samples must be dried to a constant mass. Constant mass for aggregate has been reached when _____; constant mass for soil has been achieved when _____.
   a. **Aggregate** - - there is no change in mass after 1 hour of additional drying in an oven at a temperature of 230 ± 9º F.
      Soil - - there is less than 0.1% change in mass after some additional period of drying (depending on heat source used).
   b. **Aggregate** - - there is not more than 0.1 percent change in mass after thirty minutes of additional drying in an oven at a temperature of 230 ± 9º F.
      Soil - - there is no change in mass after one hour of additional drying in an oven at a temperature of 230 ± 9º F.
   c. **Aggregate** - - there is less than 0.1% change in mass after some additional period of drying (depending on heat source used).
      Soil - - there is no change in mass after one hour of additional drying in an oven at a temperature of 230 ± 9º F.
   d. There is less than 0.1% change in mass for either aggregate or soil.

3. Given the following masses for a sample of material, what is the change in moisture content, calculated to the nearest 0.01 percent? Has the sample achieved constant mass as determined for aggregate (Yes/No)?

$$\frac{M_P - M_N}{M_P} \times 100$$

Empty container mass	648.6 g
Mass after first drying cycle (container + sample)	4143.4 g
Mass after second drying cycle (container + sample)	4139.5 g

   a. 0.11 - - No
   b. 0.09 - - Yes
   c. 0.11 - - Yes
   d. 0.09 - - No
   e. None of the above.

T 99 / T 180 MOISTURE-DENSITY RELATIONS OF SOILS

4. Under which conditions is it necessary to prepare samples for each compaction point?
   a. For materials that degrade during compaction.
   b. For clay materials that require an extended period for water to absorb to a uniform moisture content.
   c. a & b
   d. Always, due to the large required sample size for moisture content of granular materials.
   e. None of the above.

5. Mass determination of compacted samples must be made to at least what degree of accuracy?
   a. 0.1 gram or 0.01 lb.
   b. 5 grams or 0.05 lb.
   c. 0.005 kg. or 0.01 lb.
   d. All of the above.
   e. None of the above.

6. When performing a T 99 Method B, fill the mold in _____ approximately equal layers and compact each layer with _____ blows of the rammer.
   a. 3 - - 25
   b. 5 - - 25
   c. 3 - - 56
   d. 5 - - 56

Calculations

7. Calculation of Wet and Dry Density:

$$\rho_d = \left(\frac{\rho_w}{w + 100} \right) \times 100 \qquad \text{or} \qquad \rho_d = \left(\frac{\rho_w}{1 + \frac{w}{100}} \right)$$

ρ_w = Wet Density (lb/ft^3)
ρ_d = Dry Density (lb/ft^3)
w = Moisture Content (%)

Known:

1 pound = 453.6 g
Mold Factor (Select the correct one): 13.33 or 30
Mass of Moist Soil and Mold: 6593.1 g
Mass of Mold: 4366.4 g
Mass of Moist Soil: _____ g
Soil Moisture Content: 11.1%

For a sample compacted using **Method C**, the wet density is _____ lb/ft^3.
The dry density is _____ lb/ft^3.
The sieve size used during sample preparation is _____.

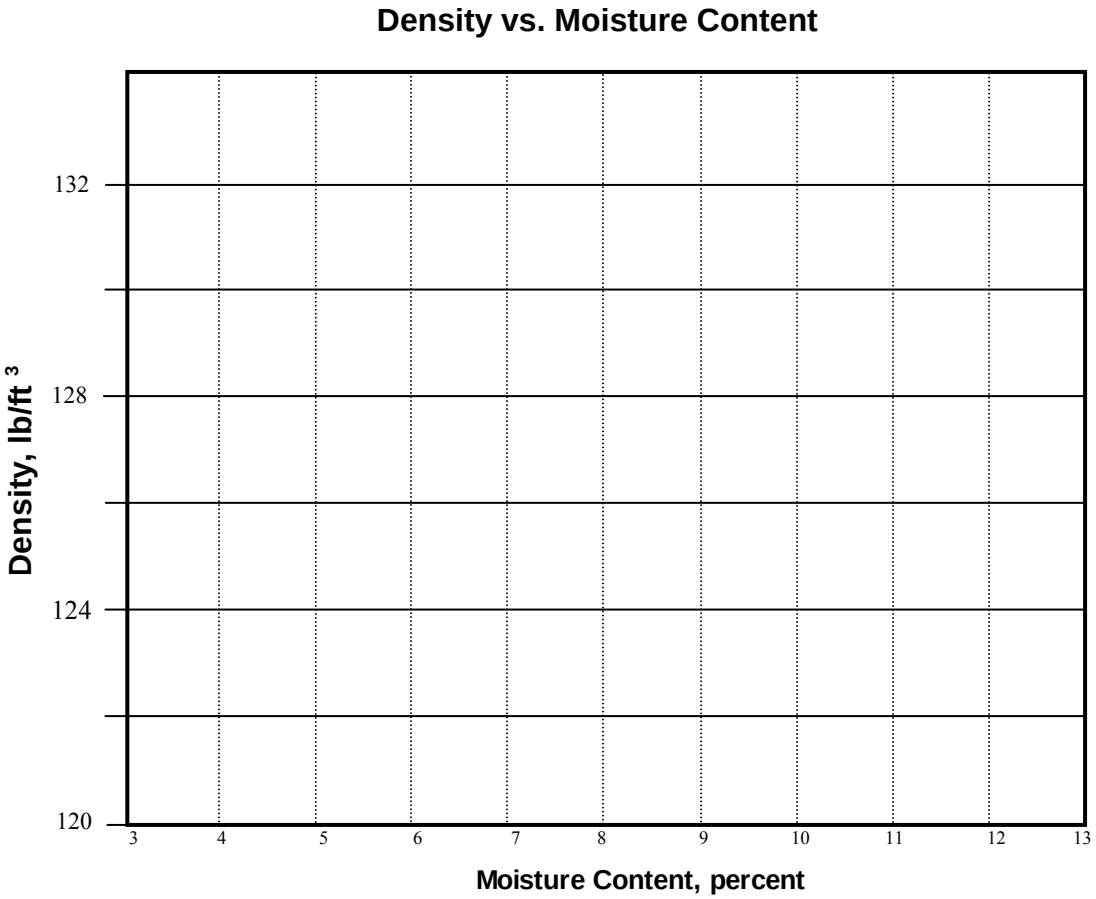
a. 147.3 - - 132.6 - - 3/4 in.
b. 128.3 - - 115.5 - - 3/4 in.
c. 128.3 - - 115.5 - - No. 4
d. 147.3 - - 132.6 - - No. 4
e. None of the above.

Calculations (Continued)

8. Plot the following dry density and corresponding moisture content values on the graph below.

Dry Density, lb/ft^3	Moisture Content, %
123.7	3.8
127.2	6.1
129. 9	8.2
129.0	9.9
127.1	11.0

The approximate values for maximum dry density and optimum moisture are…



T 272 FAMILY OF CURVES – ONE-POINT METHOD

9. Describe the nature of curves with higher densities vs. those having lower densities.

10. According to this FOP, how does one decide whether the data from the one-point determination is valid for use in estimating a new maximum dry density and optimum moisture?

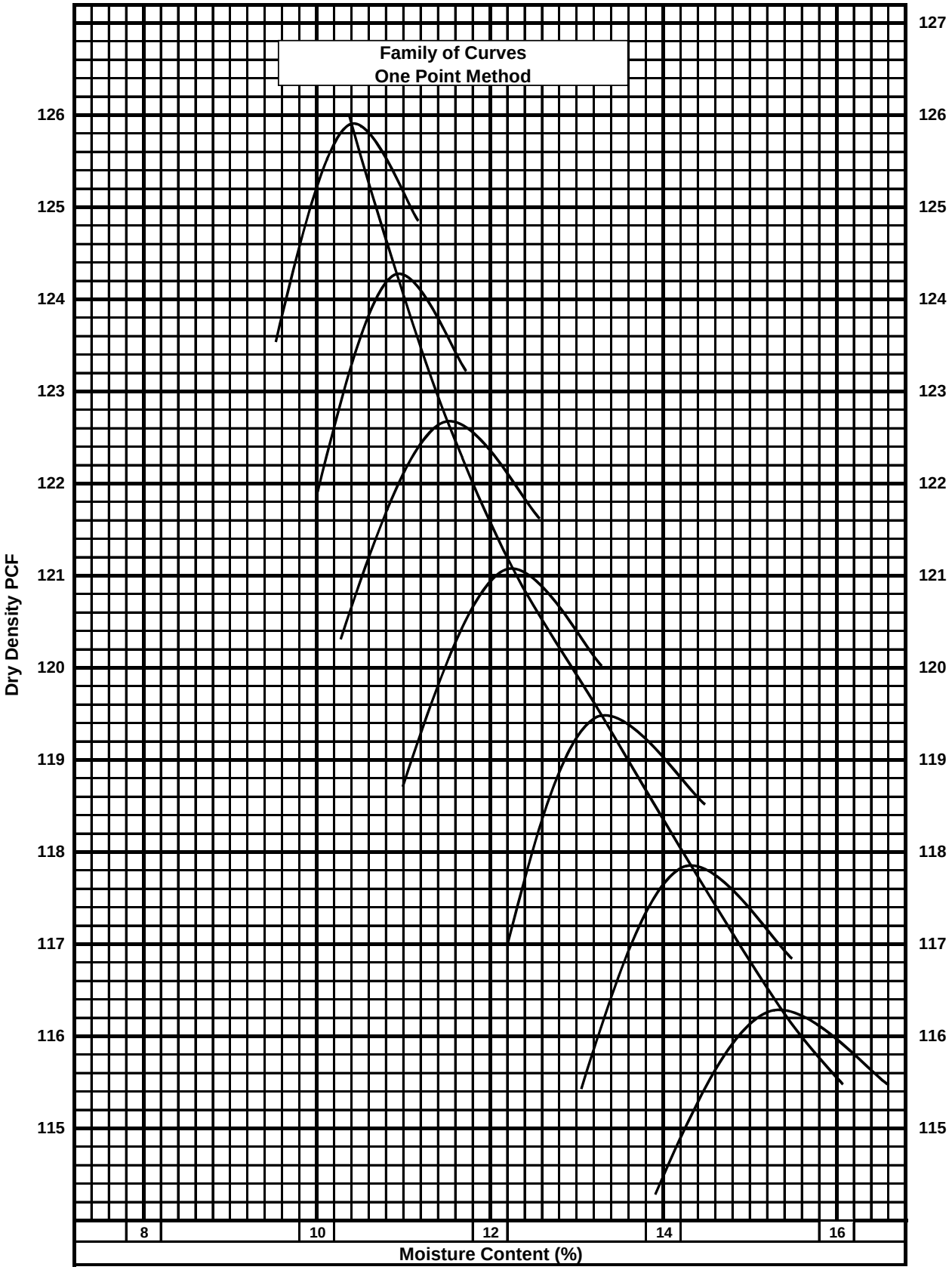
Calculations

11. Use the family of curves to determine maximum dry density and corresponding optimum moisture content.

    Known: One-point determination = 125.4 lb/ft^3 @ 10.7%.

    The estimated maximum dry density and optimum moisture content is _____. May this procedure be used given the one-point results? What must be done?

**** SEE GRAPH NEXT PAGE**


Family of Curves
One Point Method
Dry Density PCF
127
126
125
124
123
122
121
120
119
118
117
116
115
8
10
12
14
16
Moisture Content (%)

T 85 SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

Calculations

Perform calculations and determine the values requested using the appropriate formulas below.

Where:

$$\text{Bulk Specific Gravity } (G_{sb}) = \frac{A}{(B-C)}$$

$$\text{Bulk Specific Gravity } (G_{sb}\ \text{SSD}) = \frac{B}{(B-C)}$$

$$\text{Apparent Specific Gravity } (G_{sa}) = \frac{A}{(A-C)}$$

$$\text{Absorption} = \frac{B-A}{A} \times 100$$

Sample	A Oven Dry Mass, g	B SSD Mass, g	C Weight in Water, g
1	2333.6	2346.2	1506.2

12. The reported G_{sb} is: _____

13. The reported G_{sb}(SSD) is: _____

14. The reported G_{sa} is: _____

15. The reported Absorption is: _____

Do the results make sense (Yes/No)? _____

If results do not make sense, why?

_____

_____

_____

_____

_____

_____

T 224 CORRECTION FOR COARSE PARTICLES IN THE SOIL COMPACTION TEST

16. This FOP is used to adjust the lab dry density and optimum moisture values determined when encountering coarse particles.
    a. True
    b. False

17. What particle sizes constitute coarse material? How is this related to the different methods of T-99 and T-180 (A, B, C & D)?

_____

_____

_____

_____

Calculations

18. Calculation of adjusted dry density and optimum moisture content.

Known:

Laboratory maximum dry density	D_f	= 131.1 lb/ft^3
Laboratory optimum moisture content	MC_f	= 8.4 %
Moisture content of coarse particles	MC_c	= 2.0%
Percent (oversize) coarse particles	P_c	= 20%
G_{sb} of coarse particles		= Use assumed value
Density of water		= 62.4 lb/ft^3
Density of (oversize) coarse particles	k	= G_{sb} × density of water

$$D_d = \frac{100\, D_f k}{[(D_f)(P_c) + (k)(P_f)]} \qquad MC_t = \frac{[(MC_f)(P_f) + (MC_c)(P_c)]}{100}$$

Using the information presented above, the adjusted values for maximum dry density and optimum moisture are…

_____

_____

T 89 DETERMINING THE LIQUID LIMIT OF SOILS

19. The moisture at the boundary between the plastic and solid states is known as the…
    a. Liquid Limit
    b. Plastic Limit
    c. Shrinkage Limit
    d. Plasticity Index
    e. None of the above.

20. Which of the following describes the number of "cuts" that may be used to divide the soil in the liquid limit cup?
    a. 1
    b. 2
    c. 4
    d. 6
    e. All of the above.

Calculations

21. Method B (Single Point)

N = blow count
W_N= % moisture

N	$(N/25)^{0.121}$	N	$(N/25)^{0.121}$
22	0.985	26	1.005
23	0.990	27	1.009
24	0.995	28	1.014
25	1.000		

$LL = (w_N)(N/25)^{0.121}$

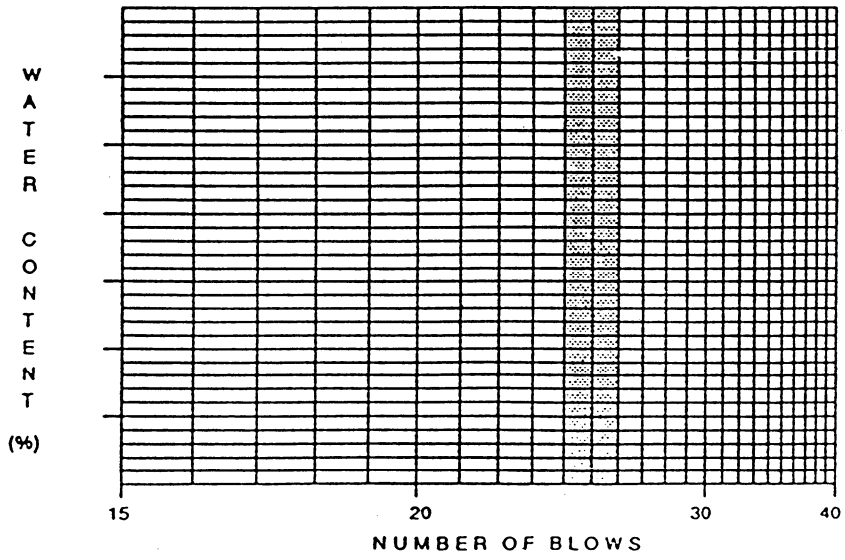
For this method of test, the reported Liquid Limit of a soil having a blow count of 28 corresponding to moisture content of 33.7% is:

_____

22. Method A (Multi-Point)

Blows	Moisture Content, %
18	38.0
22	32.4
32	24.5

Using the liquid limit data presented above, plot the data on the graph provided and determine the Liquid Limit as reported.



T 90 DETERMINING THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS

23. When conducting the plastic limit test, how many grams of material must be obtained after mixing with water? How many grams of material are used for each individual determination?
    a. 20 - - 8
    b. 20 - - 1.5
    c. Approximately 8 - - 4
    d. Approximately 8 - - 1.5 to 2
    e. None of the above.

24. During the first rolling of the material, it is important that the entire sample achieve a thread diameter of 1/8 in. without crumbling. After successful completion of this step, which of the following must be done to complete the test?

    a. Break the thread into six or eight pieces and squeeze the pieces between thumbs and fingers into an ellipsoidal-shape mass.
    b. Attempt to re-roll the sample into a uniform thread of 1/8 in. diameter.
    c. Continue reforming the pieces and rolling until the thread crumbles exactly at the 1/8 in. diameter. If the sample crumbles at a diameter greater than 1/8 in. start the test over.
    d. a & b
    e. All of the above.
    f. None of the above.

Calculations

25. Calculate the Plastic Limit for the container requested.

Container	Container Mass, g	Container and Wet Soil Mass, g	Container and Dry Soil Mass, g
1	14.67	25.65	24.47
2	14.32	24.69	23.62
3	14.19	19.83	19.34

The reported Plastic Limit for the soil in Container 2 is:

    a. 7.5
    b. 8
    c. 11.5
    d. 12
    e. None of the above.